PATENT SPECIFICATION

DRAWINGS ATTACHED

842,620

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International Classification :—A01f.

COMPLETE SPECIFICATION

Improved Rotary Cutting Mechanism

We, MASSEY-FERGUSON INC., formerly named MASSEY-HARRIS-FERGUSON INC., a corporation organised under the laws of the State of Maryland, one of the United States of America, of 1721 Packard Avenue, Racine, Wisconsin, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to rotary cutting mechanisms of the pivoted knife type such as are commonly employed in forage harvesters.

In most rotary cutting mechanisms of the type stated, it is desirable that the mechanism has substantial momentum as it rotates, in order to produce a so-called " flywheel effect," for the obvious purpose of smoothing out variations in power requirements. This is especially true in a cutting mechanism of a forage harvester because of the large variations in the rate of feed of the crop material to be chopped, which variations would otherwise cause fluctuations in the speed of the mechanism. Such speed fluctuations are detrimental to other functions of the mechanism, for example, the delivery of the chopped material.

Obstacles, such as pieces of wood or stones, are frequently fed into the cutting mechanism with the crop material. The impact imposed on the mechanism when it encounters such an obstacle increases directly with the momentum, or moment of inertia, of the rotating mechanism. If the mechanism is made heavier to minimize damage to itself, the moment of inertia is thus increased and the problem is aggravated. It is impossible, due to practical considerations, to design a cutting mechanism of such rigidity and strength as to be safeguarded against damage regardless of the nature of obstacles to be encountered.

It is an object of the present invention to provide a cutting mechanism of the type stated, in which a pivoted knife assembly of relatively low inertia is provided and in which the location of the pivot is such as to allow sufficient rearward motion of the knife to give adequate clearance for obstacles and at the same time provide a sufficient forward urge to hold the knife assembly in its normal cutting position against the normal cutting reaction of the crop material.

Therefore the invention is a rotary cutting mechanism comprising a body which is rotatable about an axis and at least one knife assembly which has an outer cutting edge and an inner pivotal connection with said body ; and a stop which is provided on said body so as to be engaged by said assembly in the rotation of the body in order to determine the cutting position of the assembly, the arrangement being such that the centre of gravity of the assembly is disposed to the rear of the radius from said axis through the pivoted connection so that the centrifugal force will urge the assembly to maintain the engagement with the stop during normal cutting.

Preferably, the knife edge is disposed at a substantial distance to the rear of said radius to ensure that whenever a knife strikes an obstacle in the crop material being chopped, so that the knife assembly swings rearwards relatively to the rotating body, the knife will move inwards quickly into a position giving ample clearance for the obstacle.

An example of the cutting mechanism is shown in the accompanying drawings, in which :—

Fig. 1 is a side elevation partly in section, of the rotary cutting mechanism of a forage harvester, the section being on the line 1–1 of Fig. 2, which is a rear elevation partly in section, of the mechanism.

The mechanism shown includes a so-called " chopping cylinder " C, which is a rotary knife-carrying body that is rotatably mounted by its shaft 10 in any suitable support structure. A sprocket or pulley (not shown) is usually secured to shaft 10 for transmitting

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power from a power source (not shown) and driving the cylinder at high speeds. In the example, the support structure comprises vertical angle members 11, 12 and 13 ; transverse members 14, 15, 16 and 17; and longitudinal angle members 18, 19, 20 and 21. These members are all rigidly secured together by bolts 22. A sheet metal housing comprises end walls 24, 25 and arcuate portions 26, 27 which enclose a substantial portion of the cylinder. Two transversely arranged angle members 29, 30 are rigidly secured at their ends to the members 11 and 12 and they have a feed plate 31 secured by bolts 31a. Crop material is fed over the plate 31 and through the inlet opening formed by the adjacent edges 32, 33 of the arcuate portions 26, 27 respectively. A conventional shear bar 35 is secured to the angle 30, the bar being adjustable up and down by a screw device indicated conventionally at 35a in Fig. 1. The shear bar co-operates with knives 40 on the cylinder C which cut the crop material as it passes over the shear bar. The cut material is then carried by the knives 40 and scoop-shaped transverse plates 41, more fully referred to herinafter, along the housing portion 27 and is thrown therefrom through a discharge opening provided between the ends 43, 44 of the housing portions 26, 27 respectively. The discharge opening may be in communication with a delivery spout (not shown) which guides the material moving at a high speed through said opening, into a receptacle.

In the example, the cylinder C is of moderately narrow width as Fig. 2 shows. However, the invention is equally applicable to wider cutter cylinders and also to the extremely narrow flywheel type of cutting mechanisms. As shown, a pair of hubs 45, 46 are spaced axially along the shaft 10 and they are fixed to it by keys 47. Secured to an annular central flange 48 of each of the hubs 45, 46, by bolts 49, there is a pair of parallel, spaced plates 50, 51. These hubs and plates, with the shaft 10, form a rotatable body 52. Between the plates 50, 51 forming both pairs there are swingably mounted four identical knife assemblies 53. The arms 55 of the knife assemblies are pivotally mounted at their inner ends on pins 56 which extend through holes in the plates 50, 51 and are held by cotter keys 57. The cylinder is rotatable in the direction indicated by the curved arrow in Fig. 1 and the knife assemblies 53 are limited as regards movement in this direction relative to the body 52 by stop pins 59, which also extend through holes in the plates 50, 51 and are held by cotter keys 60.

The plates 50, 51 are cut away as at 62 so as to permit the knife assembly to swing backwardly farther, as shown in dotted lines in Fig. 1 than it would otherwise be able to and thereby obtain more clearance between the knife 40 and the shear bar 35 when an obstacle is encountered.

Associated arms 55 on the hubs 45, 46 are held together by the knives 40, which are secured to the outer ends of the arms by bolts 63 screwed into the arms 55. The plates 41 also are rigidly secured to the associated arms 55 by screws 64. The plates 41 not only make the knife assemblies rigid, due to the curved cross sectional shape, but also ensure positive delivery of the chopped material and preclude any material from psasing over the backs of the knives and thereby losing speed. Each plate 41 can be made relatively heavy and rigid while each knife 40 can be made of lighter material.

Each knife assembly 53 can be considered as a single integral unit comprising the members 40, 41 and 55. The centre of gravity through a cross section of the assembly is at the point G shown in Fig. 1. It will be noted that in the cutting position shown, i.e., when the arms 55 are against their stop pins 59, the centre of gravity is disposed at a considerable distance behind the pivot bolts 56, considered in the direction of rotation ; that is to say, the radial arrow V through the centre of gravity G makes a considerable angle behind the radius R through the axis of pivot. It will be seen in Fig. 1 that the arms 55 are bulged considerably rearwards to give the desired disposition of the point G. Moreover, the cutting edge 70 of the knife is also at a considerable distance behind the radius R, or in other words behind the pivot 56. In operation the centrifugal force acting on the knife assembly in the direction of the arrow V produces on the knife assembly a forward turning moment which urges the assembly to occupy the cutting position in which the arms 55 engage and bear against the stop bolts 59. The arrangement is such that under normal chopping conditions the centrifugal force holds the cutting assembly in the correct cutting position. In Fig. 1, the reaction of the crop to the cutting force is indicated by the arrow S.

In the event that impact by an obstacle imposes on the knife assembly a force in the direction of the arrow S so great as to overcome the holding effect derived from the centrifugal force, the knife assembly will swing rearwards and the knife edge 70 will retreat inwards from its normal circular path at a large angle, so that considerable clearance from the shear bar 35 is ensured.

In designing the cutting mechanism for maximum efficiency and economy, it is desirable to provide a knife assembly of low inertia and with sufficient clearance between the knife and shear bar when necessary, and to provide for a forward urge due to centrifugal force sufficient to hold the knife edge in cutting position under normal conditions. The primary factors, therefore, to be considered in such a design are the mass of the knife assembly, the radial distance of the pivot 56 from the axis of rotation, the radial distance of the

centre of gravity G from the axis of rotation and from the pivot, and the distances of the centre of gravity G and the knife edge rearwards from the radius R passing through the axis of pivot.

The momentum of each knife assembly in its circular path is small compared with the angular momentum of the entire cutting cylinder, so that any damage due to a knife striking an obstacle is minimized or avoided. However, clean and positive cutting action is not sacrificed because the knife will maintain its cutting position under normal shearing forces.

With a cutting mechanism made in accordance with this invention, light weight and relatively inexpensive knives may be utilized because the damaging impact to the knives decreases as their weight decreases. Frequency of knife replacement as well as sharpening is correspondingly reduced. Alternatively, the knives may be heavy for heavier work, although the body portion of the cylinder may be of light weight construction because impact forces are generally not of serious consequence with a mechanism made in accordance with this invention.

WHAT WE CLAIM IS:—

1. Rotary cutting mechanism of the type stated comprising a body which is rotatable about an axis, at least one knife assembly which has an outer cutting edge and an inner pivotal connection with said body and a stop which is provided on said body so as to be engaged by said assembly in the rotation of the body in order to determine the cutting position of the assembly, the arrangement being such that the centre of gravity of the assembly is disposed to the rear of the radius from said axis through the pivotal connection so that the centrifugal force will urge the assembly to maintain engagement with the stop during normal cutting.

2. Rotary cutting mechanism according to Claim 1, in which the knife edge is disposed at a substantial distance to the rear of the radius through the pivotal connection.

3. Rotary cutting mechanism according to Claim 1 or 2, in which the knife assembly comprises two axially spaced arms, the inner ends of which have pivotal connections with hubs on a rotary shaft and the outer ends of which are rigidly interconnected by the knife.

4. Rotary cutting mechanism according to Claim 3, in which the arms are each formed with a pronounced rearward bulge to ensure a substantial rearward disposition of the centre of gravity.

5. Rotary cutting mechanism according to Claim 3 or 4 in which the knife assembly includes a scooplike plate rigidly securing the arms together.

6. Rotary cutting mechanism according to any preceding claim in which the rotatable body is equipped with a number of pivoted knife assemblies all co-operating with a shear bar.

7. Rotary cutting mechanism of the type stated substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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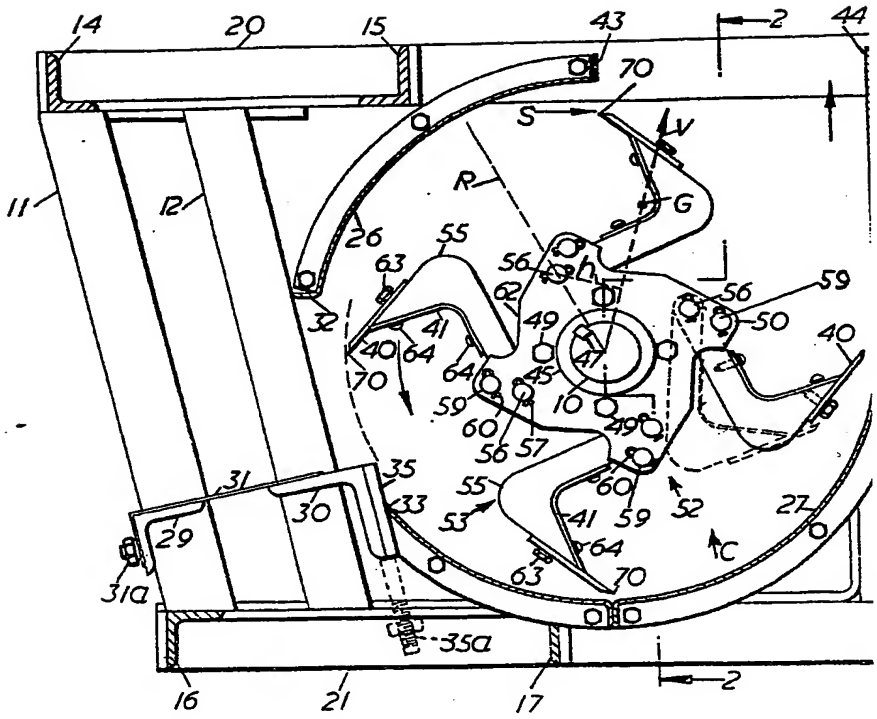
FIG.1.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842,620 COMPLETE SPECIFICATION

1 SHEET

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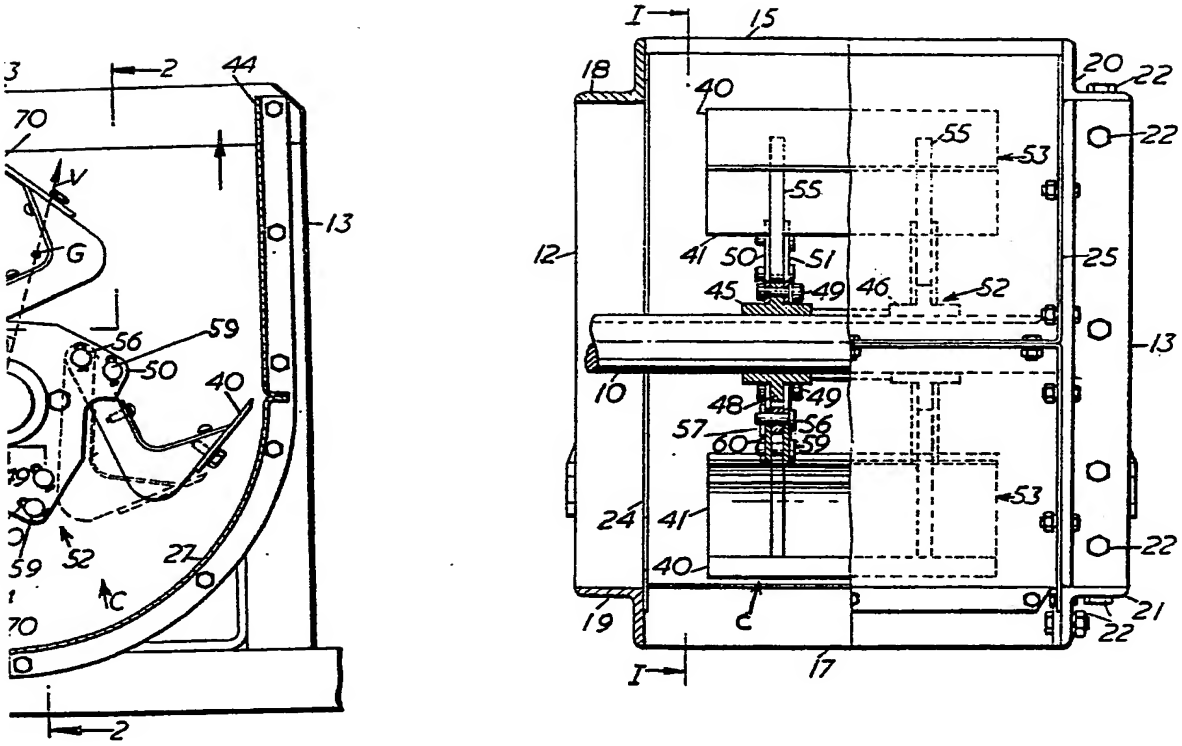
FIG.2.



842,620 COMPLETE SPECIFICATION

1 SHEET

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FIG.1.

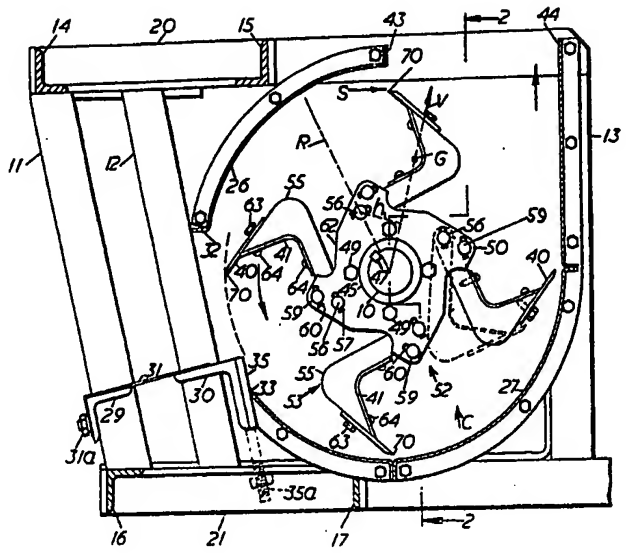

FIG.2.